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(71) Applicant (for all designated States except US): BAE SYSTEMS INFORMATION AND ELECTRONIC SYSTEMS INTEGRATION INC. [US/US]; 65 Spit Brook Road, NHQ01-719, Nashua, NH 03061 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): POMERANZ, Leonard, A. [US/US]; 9 Deer Run Road, Hollis, NH 03049 (US).

(74) Agent: LONG, Daniel, J.; Bae Systems Information and Electronic Systems Integration Inc., 65 Spit Brook Road, NHQ01-719, Nashua, NH 03061 (US).

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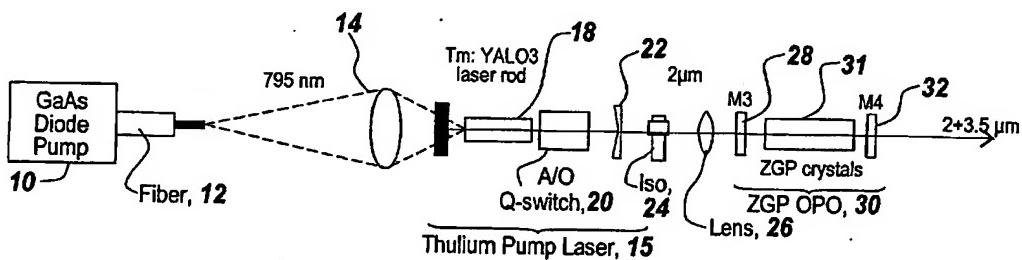
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(54) Title: THULIUM LASER PUMPED MID-IR SOURCE WITH BROADBANDED OUTPUT



(57) Abstract: A Thulium laser is used to directly drive a ZnGeP<sub>2</sub> optical parametric oscillator with a nominal 2 pm output to generate the 3-5 micron wavelengths. In one embodiment, the ZGP OPO is configured as a linear resonator and in another embodiment the ZGP OPO is configured as a ring resonator. The ring resonator prevents optical feedback to the Thulium laser and eliminates the need for an optical isolator. Moreover, the Thulium laser pump is implemented as a Tm:YA<sub>10</sub><sub>3</sub> laser in which YA<sub>10</sub> is the host for the Thulium. YA<sub>10</sub> is particularly beneficial as it is a mechanically hard optical material allowing high thermal loading without fracture as well as natural birefringence that can minimize thermal birefringence losses. A longer wavelength transition at 1.99 microns is selected to minimize nonlinear crystal loss. More particularly, a high power, high efficiency Tm:YA<sub>10</sub><sub>3</sub> laser repetitively Qswitched at 10 kHz is used to drive a ZnGeP<sub>2</sub> OPO. The system is run with room temperature components and achieves over 3 W at 3-5 microns with an efficiency of 5% starting from the pump diode. A two crystal resonator design allows tuning over multiple spectral peaks or alternately as an ultra broad spectral source.

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## INTERNATIONAL SEARCH REPORT

International application No.

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### A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01S 3/11  
US CL : 372/10,13,21,70

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
NONE

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,099,486 (Acharekar et al.) 24 March 1992 (24.03.1992), entire reference	7-10
Y		1-6, 11-18
Y	US 5,682,397 (Scheps) 28 October 1997 (28.10.1997), entire reference	1-6, 11-18
Y	US 5,193,096 (Amano) 9 March 1993 (09.03.1993), entire reference	1-6, 11-18
Y	US 5,742,632 (Barnes et al.) 21 April 1998 (21.04.1998), entire reference	1-6, 11-18
A	US 5,610,933 (Jani et al.) 11 March 1997 (11.03.1997), entire reference	1-6, 11-18

Further documents are listed in the continuation of Box C.

See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means		
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Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

  
Sandra O'Shea

Telephone No. (703) 308-7724